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On the Expansion of Wood by Heat, in a Letter from
DAVID RITTENHOUSE L. L. D. *President of the*
Society.

May 15th, 1795.

IN the present state of experimental philosophy it is well known that bodies in general enlarge their dimensions, or expand, on being heated, and contract in cooling. From some experiments heretofore made, wood has been thought to make an exception to the general rule, and this opinion has so far prevailed that many curious persons have applied wooden pendulum rods to their time-pieces, to prevent the variation in their rate of going, arising from the expansion and contracting of a metal rod. From my own observations, however, as well as those of some of my friends, the wooden pendulum rod does not appear to answer the expectations formed on it. I had in my possession for several years an excellent time-piece made for this society by an ingenious workman and worthy member of the society. The result of my constant attention to this clock was, that though its regular variations with heat and cold were probably much less than those of metal pendulums, it nevertheless always went faster in winter than in summer, and was liable to very sudden and considerable variations; arising, no doubt, from the combined effects of heat and cold, moisture and dryness. This determined me to make some careful experiments with a pyrometer capable of receiving a piece of wood of the length of a second pendulum. Several years ago I made some experiments of this kind, perfectly corresponding with those I have lately made, and which I now communicate to the society.

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I took a straight grained piece of white hickory, green, for I could not procure any seasoned, its length 39 inches, and about $\frac{3}{8}$ of an inch square. This I placed in my pyrometer, and kept it fully extended by a weight fastened to a string, going over a pulley. To the pyrometer I applied the tube and glasses of a good compound microscope, and a micrometer, the value of the smaller divisions whereof I found to be nearly .00053 parts of an inch, each.

The rod of wood being placed in the pyrometer, I poured sand all around it, heated to about 250 of Fahrenheit, which degree of heat I found the wood would bear without scorching. On pouring in the hot sand, the rod expanded very much, but soon began to contract, even before the sand was sensibly cooled, which I suppose arose from the hot sand extracting the moisture of the wood. It continued to contract as the whole grew cool, so that when the rod had acquired its first temperature it was near 30 of the above divisions shorter than at first. I repeated the operation a second and third time, and had then reason to conclude that the wood was nearly as dry as it would become by lying long in a dry air. I now let it cool to the temperature of the atmosphere which was 75° and heating the sand to 200 only, I poured it around the rod. In a few minutes it expanded 16 divisions. In half an hour the sand had cooled to 125, and the rod had contracted 11 divisions. In an hour more the sand was 80 and the rod shortened full 4 divisions more, being nearly equal to its length when the sand was first applied. On the whole I conclude that very dry wood expands with heat pretty regularly, though certainly in a much less degree than any of the metals or even glass.

DAVID RITTENHOUSE.

To the Philosophical Society

P. S.

May 12th 1796.

P. S. The rod above mentioned having been kept in a dry place for twelve months, I again tried it with the pyrometer, having fixed near one end of it a small graduated scale of ivory, 360 divisions whereof were equal to one inch. This scale was viewed with the microscope, furnished with a cross hair, and I thought this method preferable to the screw micrometer used before.

The rod was placed in the pyrometer when the temperature of the air was about 60° . On pouring sand around it, heated a little higher than boiling water perhaps, it immediately expanded $\frac{1}{2}$ a division, but in less than a minute it began to contract, and continued to do so for an hour, when I drew off the sand. It was now full 10 divisions shorter than at first, so that it had imbibed a great deal of moisture from the air which it again parted with to the heated sand. Three hours afterwards when the rod was cool, I again poured the sand on it, heated as before. It now continued to expand for about three minutes, when its length was increased $3\frac{1}{4}$ divisions, it then began to contract, and became full 3 divisions shorter than when the sand was poured on it. I caused the sand to run off once more, and let the rod cool. Then heating the sand 250° by a thermometer, I poured it on the rod, and in a few minutes it expanded $3\frac{3}{4}$ divisions, it then began to contract slowly, and in 15 minutes it became $\frac{1}{3}$ of a division shorter than at first. On the whole I concluded that the expansion of wood, in its length, will be irregular, corresponding partly to the warmth, and partly to the moisture of the atmosphere.

D. RITTENHOUSE.